

Consumer preferences and marketing strategy for black pule (*Alstonia spectabilis*) antimalarial tablet prototypes in South Central Timor

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ABSTRACT

Malaria remains endemic in eastern Indonesia, and resistance to conventional antimalarial drugs necessitates alternative treatments. Black pule (*Alstonia spectabilis*) is one of the plants that has been researched and claimed to be a natural ingredient that can treat malaria. Black pule prototype has been prepared for the downstream stage through commercialization. Before that, it is necessary to conduct marketing research to ensure the success of the marketing. Therefore, this study evaluates consumer preferences and formulates marketing strategies for black pule antimalarial tablets. This study involved 100 respondents selected using cluster and purposive sampling across three malaria-endemic sub-districts in South Central Timor Regency. Using a quantitative-descriptive approach, data were collected through questionnaires and analyzed with descriptive statistics. The results show that most consumer targets stated that the antimalarial tablet prototype of black pule has a good impression and characteristics. Approximately 69-77% of respondents rated the product positively across shape, color, taste, aroma, size, and overall organoleptic attributes. The results indicate that the majority of respondents gave positive evaluations and expressed a preference for the product's shape, color, taste, aroma, size, and overall organoleptic characteristics. Findings support aggressive marketing strategies for herbal antimalarial tablets in endemic regions. Based on these findings, an aggressive S-O marketing strategy is recommended, emphasizing product promotion, participation in health-related expos, strengthened digital outreach, and concise educational initiatives to improve public acceptance of the herbal antimalarial tablet.

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1. INTRODUCTION

Malaria is an infectious disease caused by protozoa of the genus *Plasmodium* and disseminated through the bite of Anopheles species mosquitoes. In Indonesia, approximately 40 million people, or about 15% of the total population, reside in malaria-endemic areas [1]. This situation is further exacerbated by the

high concentration of cases in Eastern Indonesia, with Papua Province alone accounting for 86% of all malaria cases nationwide [2]. In East Nusa Tenggara, the combination of this landscape, such as hills, valleys, and rivers, with dry-season temperatures of 30-31 °C, along with moisture-laden winds, supports the survival of malaria vector larvae [3]. Antimalarials are drugs used to prevent and treat *Plasmodium* sp., one of which is chloroquine, which has long been known as an antimalarial. However, in the 2019 Malaria Case Management Handbook, it is stated that one of the obstacles in handling malaria cases in Indonesia is that chloroquine has decreased efficacy, and resistance has even occurred [4]. Therefore, other alternative treatments are needed to overcome the resistance of these antimalarial drugs. One of them is alternative medicine using black pepper as a plant that is believed to have the potential to be used as a new antimalarial drug. The use of black pule has been used by the Tetun tribe in East Nusa Tenggara for hundreds of years as an ethnomedicine heritage [5].

In previous studies, a series of tests have been carried out to prove that this plant really has antimalarial activity. The results of the metabolite profiling test on 96% ethanol extract of black pule showed the presence of dominant alkaloid-specific compound components in the form of villalstonine (44.6101%), vincadifformine (22.2509%), and pleiocarpamine (10.2855%), which are well known to suppress antimalarial activity [6]. Consistent with this chemical profile, antiplasmodial assays revealed strong inhibition of the *Plasmodium falciparum* 3D7 strain with an IC50 value of 1.23 µg/mL [7]. These findings provide scientific validation for the long-standing traditional use of black pule in ethnomedicine for the treatment of malaria, thereby establishing the plant as a promising candidate for the development of standardized and commercially viable antimalarial products.

Despite promising pharmacological evidence, consumer acceptance and market strategy for black pule tablets remain unexplored. This is a critical gap in the downstream process of herbal product commercialization. To address this gap, the present study evaluates consumer preferences through hedonic and hedonic quality tests and further assesses market viability using a SWOT analysis. The objective of this study is to provide actionable insights for the development of effective marketing strategies for herbal antimalarial products in malaria-endemic regions, with a particular focus on the South-Central Timor context.

In this study, consumer acceptance was assessed through two sensory evaluation methods. The hedonic test was administered to 100 untrained panelists, who evaluated attributes such as shape, color, flavor, aroma, size, and overall impression. To complement this, a hedonic quality test using 25 semi-trained panelists provided a more specific assessment of key characteristics, including shape, color, flavor, and aroma. In addition, the market's viability was evaluated through a SWOT analysis, which was employed to ascertain the respondents' assessments of the product, with the objective of enhancing the efficiency and effectiveness of product marketing. The SWOT analysis method in this study was conducted to determine the external strategic factor analysis summary (EFAS), which includes strength and weakness parameters to develop the internal strategic factor analysis summary (IFAS), which includes opportunity and threat in the marketing of the product [8]. Companies that apply SWOT analysis are expected to be successful in product competition so that they can outperform competing companies and the company can continuously develop [9].

2. METHOD

This study was approved by the Ethics Committee for Health Research, Islamic University Hospital Malang with letter number 36/KEPK/RSI-U/IX/2024. The research was designed using a survey method and a descriptive quantitative approach. In order to obtain a pre-marketing analysis of the black pule tablet alternative malaria medicine product, the literature was compiled to describe the targeted consumer perspectives on the product through descriptive statistical assessment. This allowed for the determination of whether the product is suitable for the targeted consumer market conditions and the selection of the best marketing strategy for the subsequent stage of product commercialization.

2.1. Location and participant

This study was conducted in September 2024 in Central South Timor Regency, Indonesia, which is an area with moderate malaria endemicity [10]. The target respondents of this study were 100 people with inclusion criteria of residents of Central South Timor Regency aged 15-65 years with good and normal sensory abilities as representatives of the target consumers of BPAT marketing. The location and target of this study were purposively determined, with a total of 3 sub-districts selected using cluster and purposive sampling techniques. Among the sub-districts in Central South Timor Regency, SoE Sub-district, South Amanuban Sub-district, and Boking Sub-district were selected on the basis of the areas with the highest incidence of malaria in 2019 [10]. Therefore, these three sub-districts were chosen as the location and place for sampling data because with an area that still has quite a lot of malaria endemicity, the people of Central South Timor Regency are suitable if they are used as target consumers for the sale of BPAT products. The exclusion criteria encompassed individuals currently experiencing sensory impairments, residents outside the

three selected sub-districts, individuals younger than 15 years or older than 65 years, and individuals who were unwilling to provide informed consent. The formulas used in this study can be described as follows:

$$\text{Sub population sample} = \frac{\text{Total individuals in sub population}}{\text{Total population in South Central Timor Regency}} \times 100$$

Based on this calculation, the proportional sample size needed from each sub-district was calculated based on the population structure of South-Central Timor Regency. The resulting sample allocations for each district are summarized in Table 1.

Table 1. Frequency distribution table of research respondents samples based on domicile

Sub-district	Frequency (N)	Percentage (%)	Total
Soe	54	54%	100%
South Amanuban	32	32%	
Boking	14	14%	

2.2. Study procedure

Prior to data collection, all participants received an explanation of the study's purpose, procedures, potential risks, and their right to withdraw at any time without penalty. Informed consent was obtained from each participant in the study. To ensure confidentiality, no personal identifiers were collected. All responses were coded anonymously, stored securely, and accessed only by the research team. All procedures were approved by the Health Research Ethics Committee of the Islamic University Hospital of Malang.

Respondents are asked to provide a liking assessment of the sensory attributes of the BPAT product by observing, touching, examining, smelling, and tasting the product as a source of information data to obtain research data results in the form of panelists' preference levels for the product and to assess the product's quality accurately. Respondents will be provided with mineral water to neutralize their taste buds before the testing process is conducted. Next, the respondents fill out a follow-up questionnaire to evaluate the product in more detail. In the hedonic test, the 1-4 Likert scale is described in statements ranging from "Very Like" to "Very Dislike." The results of this study will determine the panelists' preference levels, which will be described by the average value and deviation of each hedonic test parameter. Concurrently, within the framework of the SWOT analysis, the 1-4 Likert scale is delineated in statements ranging from "Very Agree" to "Very Disagree." Subsequent to the collection of data, the results are processed by calculating the arithmetic mean and then dividing by the number of respondents. This calculation yields coordinates that are then analyzed using a SWOT Cartesian diagram. The data obtained from the respondent's assessment is subsequently subjected to statistical analysis utilizing Microsoft Excel and SPSS. After which, the results will be described through descriptive data interpretation.

2.3. Product description

The product used in this study was an herbal tablet made from black pule cortex extract. This product is manufactured by PT. Agaricus Sido Makmur Sentosa (ASIMAS) in Lawang, Malang, East Java. The formulation in 1 tablet 700 mg consists of 63 mg black pule extract as an active ingredient and many excipient ingredients. Description of the physical characteristics and properties that the product possesses, according to the researcher's subjective opinion, can be seen in Table 2.

Table 2. Black pule anti malaria tablet characteristics

Organoleptic aspect	Description
Shape	Oval
Color	White with light brown spot
Taste	Bitter
Smell	Typical black pule aroma
Size	700 mg/18 mm

3. RESULTS AND DISCUSSION

3.1. Hedonic test

Parameters of BPAT prototype assessed by a hedonic scale by 100 untrained panelists with good sensory condition, covering aspects of shape, color, taste, smell, size, and overall. Each hedonic scale score selected by panelists will be processed with descriptive statistical analysis to determine the mean and

percentage of each parameter from a choice of 1-4 hedonic scales. The hedonic scale is described in statements ranging from “Very Like” to “Very Dislike” ratings that are ranked through Likert scale values [11]. The results of the values that appear will determine the level of panelist preference as a representative of the level of preference of the Central South Timor Regency society for BPAT tablet products, as shown in Table 3.

Table 4 shows that the preference data scale of Central South Timor Regency panelists for BPAT resulted in average values on shape (3.15), color (3.25), taste (2.84), smell (3.19), size (2.93), and overall (3.17) preferences. The overall mean data of the organoleptic parameters were interpreted in the hedonic range with a “like” scale, indicating that most people in Central South Timor Regency liked the overall tablet prototype. The standard deviation and variance values for each parameter demonstrate noticeable deviations from the mean, suggesting a spread of individual preferences across samples. These results are visually summarized in Figure 1, which presents the percentage distribution of hedonic responses for each organoleptic attribute.

The results of the mean data on the level of liking of the Central South Timor Regency society are reinforced by the hedonic scale percentage value on the organoleptic parameters of the BPAT prototype product. Based on Figure 1, it can be seen that all aspects have the highest percentage value on the “Like” scale for the medicinal product under study. The largest percentage obtained is the “Like” hedonic scale with a value 77% for shape, 73% for color, 69% for taste, 74% for smell, 72% for size, and 77% the overall tablet organoleptic aspect. The alignment of the preference ratings across all aspects will influence whether the product is accepted or not according to consumer preferences. From the percentage data results, it can be concluded that the majority of panelists from the Central South Timor Regency community stated “Like” for the overall BPAT (*A. spectabilis*).

Table 3. Hedonic scale

Hedonic scale	Numeric scale
Very dislike	1
Dislike	2
Like	3
Very like	4

Table 4. Average panelists preference score for the pule black antimalarial tablet prototype

Parameter	Mean	Std.
Shape	3.15	0.46
Color	3.25	0.46
Taste	2.84	0.61
Smell	3.19	0.50
Size	2.93	0.55
Overall	3.17	0.38

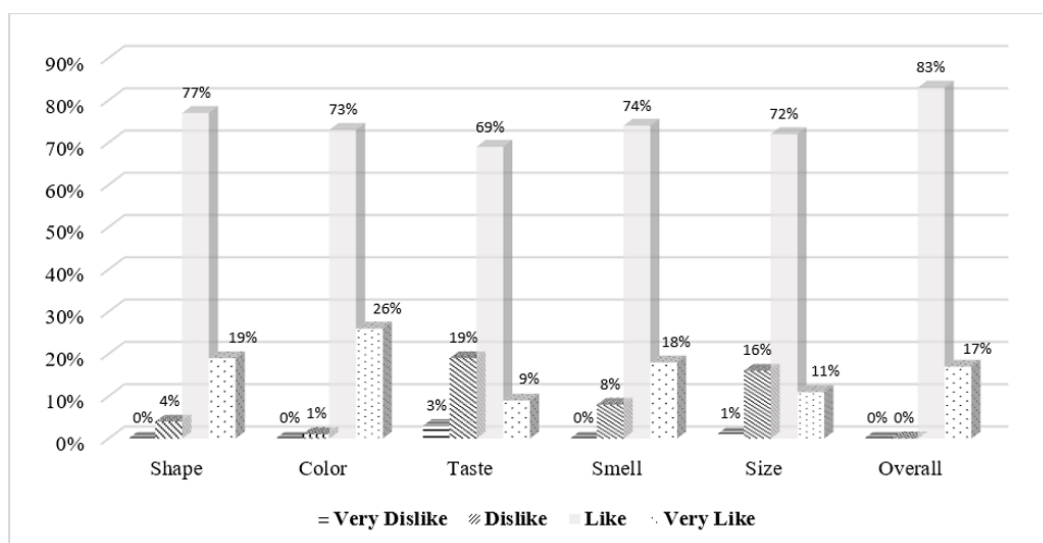


Figure 1. Hedonic test percentage graph data analysis

Although all attributes received “Like” as the highest hedonic percentage, the taste parameter showed a slightly lower score (69%) compared to shape, color, smell, size, and overall impression. This lower rating may be attributed to the inherent bitterness of *A. spectabilis*, as herbal antimalarial plants commonly contain alkaloid compounds that naturally impart a bitter taste. Even though the BPAT formulation successfully reduced the bitterness to a “less bitter” level, panelists may still have perceived mild residual bitterness, making it less preferred than other sensory aspects.

The results of this study state that attractive and convenient dosage forms can make products more acceptable [12]. The hedonic scale selection of “Like” indicates the oval shape of the tablet is favored and accepted by the target consumers. The selection of pharmaceutical products in forms preferred by consumers is usually based on elements of practicality and ease of use [13]. Color is an important component in commercial products that will be the first impression most likely to be assessed by consumers in acceptance tests because this parameter is visually visible directly through the sense of sight. Good color results will increase consumer liking for a product [14]. The statement “Like,” chosen by many panelists, indicates that the test tablet product has a good color and is acceptable to consumers.

The quality of taste in a product plays a significant role in determining consumer acceptance. Taste is also an aspect that influences the quality level of a product [15]. The aspect of smell in product marketing research is very important because this parameter is considered to be a special identity of a product to be remembered by consumers [16]. According to the theory described by Herz *et al.* [17], the scent of a product can influence consumers’ cognitive processes, emotions, and behaviors, where a pleasant aroma enhances perceived product quality and ultimately shapes consumer preferences and decision-making.

Based on further information gathering, the acceptability of the 18 mm diameter tablet weighing 700 mg by the panelists from Central South Timor Regency is still quite well received and aligns with their general preference for medication in tablet form, as evidenced by the selected “Like” scale statement. According to the United States Food and Drug Administration (FDA US) 2008, a good and recommended tablet size should not exceed 22 mm. Meanwhile, the formulated black pule antimalarial tablet, which is 18 mm in size, still complies with the recommendations for oral tablets [18], [19]. The findings of this study align with prior research on herbal medicine, where tablets are generally preferred for their convenience and dosing accuracy [20]. The acceptance of slight bitterness and mild aroma reflects cultural familiarity with traditional herbal remedies, where such characteristics are often perceived as markers of authenticity and efficacy [21], [22]. This suggests that the black pule tablet formulation suits both practical and cultural expectations in endemic regions. Nevertheless, the study is limited by its small sample size, geographic scope restricted to South Central Timor, and the absence of clinical efficacy data. Future research should expand to diverse populations and include clinical evaluations to validate both sensory acceptance and therapeutic effectiveness.

3.2. Hedonic quality test

The hedonic quality test involved 25 semi-trained panelists, who were selected from the 100 untrained panelists of the hedonic test. They were selected based on their sensory familiarity of the product, their knowledge, and their willingness to assess the product in more detail [23]. Therefore, the 25 semi-trained panelists were a subset of the untrained panelists in hedonic test. The scale used includes 4 Likert scales related to the range of organoleptic variations in each aspect of the black pule herbal antimalarial tablet product. The parameters of the BPAT tested for sensory impressions include aspects of shape, color, taste, and smell. The percentage of panelist data from the hedonic quality test can be seen in Table 5 above.

Based on Table 5, most panelists liked the BPAT with oval shape (96%), white color with light brown spots (84%), less bitter (76%), and slightly typical (48%). These results show that the panelists liked several aspects that already existed in the product and even felt that the product in the aspects of taste and aroma had better aspects than the researcher's subjective on Table 2, namely the taste of “Less bitter” which not too bitter for consumption and the aroma of “Slightly Typical” black pule which is not pungent so that the product can be accepted by most people in Central South Timor Regency.

Based on the results of the hedonic quality analysis in Table 6, it can be seen that the shape of BPAT have score of mean 1.96, which means oval. Due to the selection of quality in accordance with the observations of the product that should be with the choice of form in accordance with the tablet preparation of the product being tested. Therefore, the company does not need to re-modify the shape of the BPAT that has been designed. The selection of the oval shape of the tablet was made for a specific purpose. Black pule antimalarial tablets are formulated with a fairly large weight of 700 mg. The oval shape of large tablets will make it easier for consumers to swallow and reduce drug transit time in the esophagus [24].

Table 5. Hedonic quality test result

Aspects	Characteristic	f	Percentage (%)
Shape	Oblong	1	4
	Oval	24	96
	Round	0	0
	Ring	0	0
	Total	25	100
Color	Plain white	0	0
	White with light brown spot	21	84
	Light brown	4	16
	Dark brown	0	0
	Total	25	100
Taste	Less sweet	0	0
	No taste	2	8
	Less bitter	19	76
	Bitter	4	16
	Total	25	100
Smell	Not typical	3	12
	Slightly typical	12	48
	Typical	7	28
	Very typical	3	12
	Total	25	100

Note: f Panelist's frequency, % percentage

Table 6. Average result of hedonic quality data for the black pule antimalarial tablet prototype

Parameter	Mean	Std.
Shape	1.96	0.20
Color	2.16	0.38
Taste	3.08	0.49
Smell	2.40	0.87

Then, the color result data analysis of BPAT product has an average of 2.16, which means it is white color with light brown spot. Based on the analysis results, it can be concluded that the panelists preferred the black pule antimalarial tablets with a white color and light brown specks. The presence of spots on the tablet is due to the use of natural ingredients in the product manufacturing process, where natural ingredients have the drawback of causing speckles on the resulting tablets [25]. The appearance of these speckled spots is due to the drying process of the extract, which results in larger particle sizes than the excipients, affecting the uniformity of the granule mixture before compression [26]. But this did not reduce the panelists' preference in choosing the color impression on the tablet.

The taste of the BPAT product has an average of 3.08, which means it is less bitter. This black pule tablet product does indeed have a distinctive aroma and bitter taste. This is because the product is made from natural ingredients with a natural bitterness derived from medicinal plant materials without any added artificial sweeteners [26]. This bitter taste is indeed less suitable for some people, but most panelists believe that the taste of this tablet is in line with the general taste of medicinal tablets [23], [27]. The relatively mild bitterness is due to the addition of excipients in the tablet formulation, which serve to cover the shortcomings of the plant extract as the active ingredient [28].

The smell of the BPAT product averages 2.40, which means it has a slightly typical smell of black pule extract. The formulation results in a tablet aroma that is not very noticeable, but there is still a slight characteristic aroma from the black pule plant. The somewhat distinctive aroma in the tablet influences the panelists' preference in expressing their liking for the product. Besides being a distinctive feature remembered in the Black Pule tablet product, a mild herbal aroma in traditional medicine is generally preferred by consumers over strong-smelling herbal products as it offers a more pleasant sensory experience and improves product acceptance [29]. This mild characteristic aroma may serve as a subtle product identifier, contributing positively to brand recognition. The formulation produced a smell that is not pungent yet retains a recognizable herbal note of black pule, aligning with consumer preferences for herbal products with gentle, non-overpowering scents. Therefore, the slightly typical aroma is more likely to support rather than hinder the product's identity and acceptability.

In this study, sensory preference scores were presented as frequency percentages; however, variations in demographic factors may also play a role in shaping consumer responses. Despite the absence of stratification by age or prior experience with herbal products in the present study, it is conceivable that younger respondents, who may have less familiarity with traditional bitter herbal preparations, exhibit marginally diminished tolerance for bitterness in comparison to older participants. Conversely, individuals with regular exposure to herbal medicines may exhibit a heightened acceptance of the product's mild herbal

aroma. Consequently, future research should incorporate stratified analyses to better understand how demographic characteristics influence hedonic quality perceptions. To improve clarity and facilitate direct comparison between hedonic and hedonic quality outcomes, both datasets are combined into a comparative summary shown in Table 7.

The comparative results summarized in Table 7 provide a more comprehensive understanding of consumer acceptance by integrating both general hedonic and hedonic quality assessments. The hedonic test results demonstrate that all sensory parameters were rated within the “Like” category, indicating broad acceptance of the BPAT prototype among the general panelists. However, the hedonic quality test, conducted with semi-trained panelists, provides deeper insight into the specific characteristics that influenced these preferences. For example, although the taste parameter received the lowest hedonic mean score (2.84), the hedonic quality evaluation shows that most semi-trained panelists perceived the taste as “less bitter,” suggesting that the bitterness was noticeable yet still tolerable and consistent with expectations for herbal medicinal products.

Similarly, the color parameter received high hedonic preference, which aligns well with the hedonic quality finding that most panelists identified the tablets as white with light brown speckles, an attribute commonly associated with natural plant-derived products. This consistency between liking score and quality perception suggests that the visual appearance of BPAT supports its acceptance as a natural herbal formulation. The smell parameter also showed alignment between tests, where the general “Like” preference corresponds to the identification of a “slightly typical” aroma, which appears to be acceptable to consumers and not overly strong. In combination, these findings demonstrate that integrating of the two datasets highlights that the BPAT prototype has favorable sensory attributes overall, with taste remaining the most challenging characteristic but still within acceptable limits for herbal medicinal products. These results confirm the potential of BPAT to be well received in the target market and provide an important foundation for further product development, positioning, and marketing strategies.

Table 7. Comparative summary of hedonic and hedonic quality test results

Parameter	Hedonic mean	Interpretation	Hedonic quality mean	Interpretation
Shape	3.15	Like	1.96	Oval
Color	3.25	Like	2.16	White with light brown spots
Taste	2.84	Like	3.08	Less bitter
Smell	3.19	Like	2.40	Slightly typical
Size	2.93	Like	-	-
Overall	3.17	Like	-	-

3.3. SWOT analysis

This study utilized two types of questionnaires for the SWOT analysis, namely the IFAS and the EFAS. The IFAS questionnaire was administered to 40 internal respondents, who were part of research team involved in the product development, production, quality evaluation, and marketing planning of the BPAT. These respondents were selected based on their direct involvement and understanding of the internal processes of BPAT development, allowing them to assess internal strengths and weaknesses accurately. Meanwhile, the EFAS questionnaire was distributed to 100 external respondents from Boking District, Soe City District and South Amanuban District in South Central Timor Regency, East Nusa Tenggara Province. These respondents represented potential consumers living in malaria-endemic areas and were selected based on cluster sampling. The total of 100 participants reflects the target external community assessment needed to evaluate market opportunities and threats in the SWOT framework. Assessment at a significant level is carried out by the product owner by determining the level of urgency of each indicator or statement in the questionnaire using a scale of 1 (not important), 2 (less important), 3 (important), and 4 (very important). This assessment is used to determine the weight value in the SWOT analysis by dividing the significance level of each statement item by the sub-total number of each factor [30].

In the instrument assessment in the form of a questionnaire given to both internal and external respondents, the answers are obtained in the form of a Likert scale assessment, namely: 1 = very disagree, 2 = disagree, 3 = agree, 4 = very agree. The total value obtained is used to determine the rating value in the SWOT analysis by summing all the scores given by the respondents for each statement item, and then dividing by the number of respondents [31]. The weight and rating values obtained are used to find the score value by multiplication. The calculation of IFAS statements in this study is as Table 8.

Based on the results of the IFAS calculations, which can be seen in Table 8, the strength score is 2,259, and the weakness score is 1,051. This shows that the strength factor of the black pule antimalarial tablet product is greater than the weakness factor. If the score of the strengths and the score of the

weaknesses are added up, the final total of the internal factors in the IFAS matrix is 3.31. This value is above 2.5, which indicates that the company's internal position is quite strong. This is because it is considered to have an above-average ability to take advantage of strengths and anticipate internal weaknesses. Meanwhile, the calculation of EFAS statements in this study is as shown in Table 9.

Based on the results of the EFAS calculations, which can be seen in Table 9, the opportunity score is 1.746, and the threat score is 1.152. This shows that the opportunity factor of the black pule antimalarial tablet product is greater than the threat factor. When the opportunity score and the threat score are summed up, the final total of the external factors in the EFAS matrix is 2.898. This value is above 2.5, which indicates that the company's external position is quite strong. This is because it is considered to have an above-average ability to take advantage of opportunities and anticipate threats from the internal [32].

The value that has been obtained from the subtotal of each factor can be used to obtain coordinate points on the SWOT Cartesian diagram. In this diagram, it can describe the situation and conditions of the black pule antimalarial tablet marketing strategy, which can be seen based on the position of the quadrants on the Cartesian diagram. If the position of the coordinate point is in quadrant I, it means supporting an aggressive strategy; quadrant II develops a diversification strategy; quadrant III makes a turnaround strategy, and quadrant IV makes a defensive strategy [33]. The formula used to calculate the analysis of internal factors and external factors to obtain the coordinate points is as follows:

- X axis = IFAS = Strength Score – Weakness Score
- Y axis = EFAS = Opportunity Score - Threat Score

Where the results are obtained, namely:

- X axis = 2.259 – 1.051 = 1.208
- Y axis = 1.746 - 1.152 = 0.594

Table 8. Calculation of IFAS statements

No.	Code	Statement	Weight	Rating	Score (weight x rating)
Strength					
1.	S1	Herbal tablet with fewer side effects compared to synthetic antimalarial drugs	0.114	3.400	0.389
2.	S2	Proven antiplasmodial activity from in vivo and in vitro studies	0.114	3.725	0.426
3.	S3	Manufactured by an IoT-certified industry implementing CPOTB	0.114	3.700	0.423
4.	S4	Production facility certified with ISO 9001:2015	0.086	3.700	0.317
5.	S5	Attractive and elegant packaging	0.114	3.500	0.400
6.	S6	Packaging remains durable and portable during distribution	0.086	3.500	0.304
Subtotal strength			0.629		2.259
Weakness					
1.	W1	Limited public awareness of the product	0.086	3.275	0.281
2.	W2	The tablet size is relatively large	0.086	2.475	0.212
3.	W3	High production cost	0.114	2.875	0.329
4.	W4	Raw materials are difficult to obtain at an industrial scale	0.057	2.650	0.151
5.	W5	Raw material supply depends on a single partner	0.029	2.735	0.078
Subtotal weakness			0.371		1.051
Total (subtotal strength + subtotal weakness)			1.000		3.31

Table 9. Calculation of IFAS statements

No.	Code	Statement	Weight	Rating	Score (weight x rating)
Opportunity					
1.	O1	Herbal tablet with fewer side effects compared to synthetic antimalarial drugs	0.088	2.910	0.257
2.	O2	Proven antiplasmodial activity from in vivo and in vitro studies	0.088	3.060	0.270
3.	O3	Manufactured by an IoT-certified industry implementing CPOTB	0.118	3.040	0.358
4.	O4	Production facility certified with ISO 9001:2015	0.118	3.170	0.373
5.	O5	Attractive and elegant packaging	0.059	2.070	0.122
6.	O6	Packaging remains durable and portable during distribution	0.118	3.120	0.367
Subtotal opportunity			0.588		1.746
Threat					
1.	T1	Limited public awareness of the product	0.118	2.960	0.348
2.	T2	The tablet size is relatively large	0.088	3.370	0.297
3.	T3	High production cost	0.059	2.550	0.150
4.	T4	Raw materials are difficult to obtain at an industrial scale	0.059	2.240	0.132
5.	T5	Raw material supply depends on a single partner	0.088	2.550	0.225
Subtotal threat			0.412		1.152
Total (subtotal opportunity + subtotal threat)			1.000		2.898

These values are then plotted in Figure 2, which shows the SWOT Cartesian diagram representing the strategic position of the product. Based on the SWOT Cartesian diagram in Figure 2, it can be seen from the difference between strengths and weaknesses that the score value is higher for strengths with a difference of (+) 1.208. Meanwhile, the difference between opportunities and threats has a higher score value of

Opportunities with a difference of (+) 0.594. Therefore, it can be concluded that the situation and conditions of the BPAT marketing strategy are in quadrant I, where this quadrant describes a very favorable company situation. This is because the position of opportunities and strengths is at the right point, so that the strengths of the company can take maximum advantage of the existing opportunities. In this position, the strategy to be implemented is to support an aggressive growth policy [34]. In practical terms, an aggressive strategy in Quadrant I necessitates the company's active expansion of market reach and acceleration of commercialization efforts. This may include the distribution of BPAT through local clinics, community health centers, and community health workers in malaria-endemic areas to ensure direct access for target populations. Digital marketing channels, including social media campaigns, e-commerce platforms, and official product websites, can also be leveraged to enhance product visibility. Furthermore, the packaging should be optimized for field conditions, and pricing should remain affordable to match the socioeconomic profile of malaria-endemic regions. Finally, advancing regulatory pathways, such as securing BPOM approval and meeting GMP/CPOTB standards, is essential to strengthen credibility and support large-scale market entry. The intended strategy is that the company can maximize its strengths to take advantage of existing opportunities. In this way, weaknesses can be covered, and threats can be minimized.

The selection of strategies to be applied in this study is based on the position of the coordinate points in quadrant I, which is between strengths and weaknesses. Alternative strategies that are intended to be prepared based on a combination of internal and external factors combined in the SWOT matrix [35]. This SWOT matrix is used to compare the level of importance of each factor so that it can serve as a basis for developing four strategy alternatives, as illustrated in Figure 3.

Based on the results of the SWOT matrix shown in Table 8, four potential marketing strategy alternatives were identified. However, the most appropriate strategy used in marketing black pule antimalarial tablets is the S-O strategy. This strategy aims to support aggressiveness in marketing black pule antimalarial tablets using strengths to take advantage of opportunities owned by the company and minimize weaknesses and threats. The S-O marketing strategy that can be applied to black pule antimalarial tablets based on SWOT analysis is as follows:

- i) Participated in expo activities to introduce black pule antimalarial tablet products and their properties by explaining the advantages of herbal medicines, which have fewer side effects than synthetic chemical drugs.
- ii) Provide information about the new product that black pule antimalarial tablets are the result of research because they have passed pre-clinical trials, and are produced by industries that reach the IOT level by implementing CPOTB and have ISO 9001 2015 certification.
- iii) Promoting black pule antimalarial tablets through social media and online stores to increase sales and prove product safety is still in good condition and feasible even after shipping or distribution.

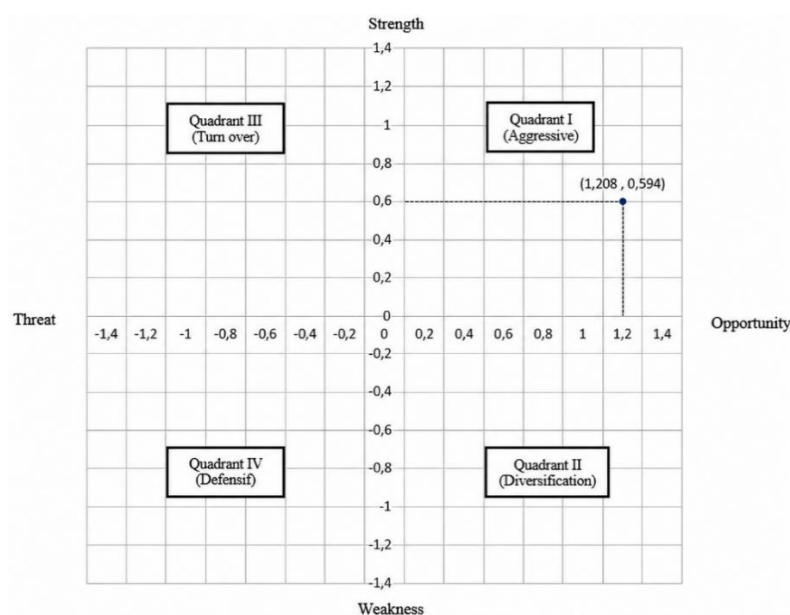


Figure 2. SWOT Cartesian diagram

Internal External	Strength 1. Herbal tablet with fewer side effects compared to synthetic antimalarial drugs. 2. Proven antiparasmodial activity from in vivo and in vitro studies. 3. Manufactured by an IOT-certified industry implementing CPOTB. 4. Production facility certified with ISO 9001:2015. 5. Attractive and elegant packaging. 6. Packaging remains durable and portable during distribution.	Weakness 1. Limited public awareness of the product. 2. Tablet size is relatively large. 3. High production cost. 4. Raw materials difficult to obtain at industrial scale. 5. Raw material supply depends on a single partner.
	Opportunity 1. Increasing public preference toward back-to-nature herbal treatments. 2. Public preference for herbal antimalarial therapy. 3. Higher trust toward research-based herbal products. 4. Demand for affordable yet high-quality medicine. 5. Significant rise in online purchases of herbal products. 6. Consumer preference for practical and easy-to-carry packaging.	W-O Strategy 1. Conduct active promotional campaigns at exhibitions. 2. Improve distribution by shipping larger batches. 3. Add new raw material partners.
	S-O Strategy 1. Participate in expo events to introduce the herbal antimalarial tablet. 2. Provide scientific information on preclinical testing and certifications. 3. Promote digitally to leverage online trends.	W-T Strategy 1. Promote via reseller networks to increase trust. 2. Modify tablet size and improve palatability.
	Threat 1. Consumers depend heavily on testimonials. 2. Preference for well-known brands. 3. Dislike for bitter-tasting tablets. 4. High interest in imported herbal products. 5. Low trust toward new products.	S-T Strategy 1. Highlight preclinical test results. 2. Emphasize ISO certification credibility. 3. Provide consumer education regarding natural bitterness.

Figure 3. SWOT matrix

4. CONCLUSION

Based on the analysis of data obtained from the research conducted, it can be concluded that the black pule antimalarial tablets (*Alstonia spectabilis*) prototype was well received by consumers in South Central Timor. This conclusion is supported by the positive results from both hedonic and hedonic quality tests, which demonstrate that the sensory characteristics of the product align well with the preferences of the South-Central Timor community, suggesting its potential suitability as a herbal antimalarial option. Furthermore, the SWOT analysis positioned the product in Quadrant I, indicating the suitability of an S-O aggressive strategy. Key strategies include strengthening product promotion, participating in health-related expos, utilizing digital platforms to highlight the product's safety, certification, and research-based development, as well as incorporating targeted educational initiatives to enhance public acceptance of herbal antimalarial therapies. For future development, it is recommended that subsequent researchers expand consumer testing to more diverse regions and collect sales data of the black pule (*Alstonia spectabilis*) antimalarial tablet as part of follow-up evaluation or for refining alternative marketing strategies. These steps will support a stronger market position and enhance the product's commercial potential.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization

M : **M**ethodology

So : **S**oftware

Va : **V**alidation

Fo : **F**ormal analysis

I : **I**nterpretation

R : **R**esources

D : **D**ata Curation

O : **O**riginal Draft

E : **E**diting

Vi : **V**isualization

Su : **S**upervision

P : **P**roject administration

Fu : **F**unding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

ETHICAL APPROVAL

The research related to human use has complied with all relevant national regulations and institutional policies in accordance with the tenets of the Helsinki Declaration and has been approved by the Ethics Committee for Health Research, Islamic University Hospital Malang, with letter number 36/KEPK/RSI-U/IX/2024.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, [NM]. The data, which contain information that could compromise the privacy of research participants, are not publicly available due to certain restrictions.

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